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Process Modification for TCE Use Reduction

Nuclear Materials Technology Division

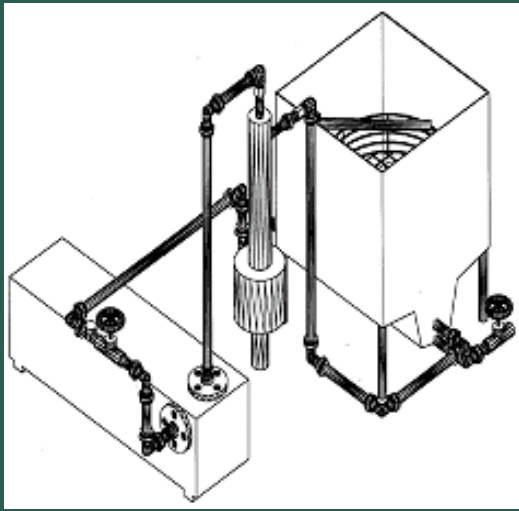

Diagram of Spray Washer design

For the near-term, trichloroethylene (TCE) will be utilized for fissile weapon component cleaning for War Reserve (WR) Pit Manufacturing. TCE has excellent solvent properties, reasonable volatility, and is nonflammable. Because of the toxic, potentially carcinogenic, and mixed-waste characteristic of TCE waste reduction strategies are being developed. Currently, many parts are cleaned in an ultrasonic apparatus that uses large amounts of TCE. A new spray washer was build that uses less TCE with the goal of replacing the more TCE intensive process with the less TCE intensive process.

The cleaning of parts, either following machining or after routine handling, requires the use of 18-liters of TCE. The current process involves the operator manually submerging the part in the ultrasonic TCE bath and manipulating it to ensure the cleaning of all surfaces. As there are no methods in place to monitor the organic contamination level in TCE or the stability of the TCE, it is replaced prior to the final cleaning of any given project, ~10-12 times a year. This results in the accumulation of more than 200 liters per year of contaminated TCE.

We developed and tested a mechanical spray washer, which operates with 4.5 liters of solvent, a 75% reduction from current usage. The washer consists of an 'F' shaped spray system in a 316 SS box, which sprays the parts to be cleaned from top, bottom and one side. One nozzle impinges on L-shaped supports on the bottom of the basket containing the pieces, rotating the basket at ~6 rpm. The system is driven by a sealless, magnetically coupled pump, which eliminates any potential for leakage along the motor shaft. This system allows for hands-off operation, reducing operator exposure to solvent. The 4.5-liter volume will eliminate the requirement for a specific operating permit from New Mexico Environmental Department (NMED) and monthly emissions calculations.

The performance of the two washing methods were compared by residue analysis of test coupons after processing by both cleaning technologies. The test coupons were representative of the parts that are cleaned in WR work and were contaminated with three different oil types in a controlled manner. The oils and greases (Apiezon N vacuum grease, Texaco Regal R&O 32 oil, and Nye watch oil.) were chosen to represent actual materials used in parts processing.

The data indicated that the spray washer was as effective at cleaning the coupons as the ultrasonic method if the time of washing is greater than 5 minutes. There was no significant difference between the 5-minute and 10-minute spray wash results. The cleaning efficiency of the spray washer technology was shown to be equivalent to the ultrasonic washer. Solvent quality seemed to be unchanged during the course of the study. Contaminants were redeposited on test coupons as the solvent became loaded with oils; TCE with oil levels of > 500 ppm should be purified.

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